Journal of the Society of Arts.

FRIDAY, DECEMBER 21, 1855.

UNION OF COLONIAL SCIENTIFIC INSTITUTIONS WITH THE SOCIETY OF ARTS.

The Council of the Society of Arts, having received an application from the Jamaica Society of Arts to be taken into Union, on the same footing as the Mechanics' Institutions of Great Britain and Ireland, have had under consideration for some time past the means of most effectually extending the benefits of the principles of association and co-operation to similar Societies throughout the British Colonies and India. With this view they have laid down the following conditions and terms of Union:—

I.—The Society of Arts is prepared to receive into Union any Institution, established in a British Colony, or in the British Possessions in India, for the advancement of Literature and Science, or for the Encouragement of Arts, Manufactures, and Commerce.

II.—It shall be the duty of the Officers of the Society of Arts to correspond with the Secretaries of such Associated Colonial Institutions, on matters relating to their recognised objects.

III.—The productions or manufactures of a Colony, transmitted by a Colonial Associated Institution, shall receive all due publicity, by means of the Society's Exhibitions, Publications, and Discussions.

IV.—The weekly *Journal* of the Society, with its other publications, shall be duly forwarded to every Associated Colonial Institution, and a portion of the columns of the *Journal* shall be reserved for Colonial Discussions and Correspondence.

V.—Whenever any member of an Associated Colonial Institution, bearing a letter of introductian from its Secretary, shall visit London, he may enjoy the usual privileges of a Corresponding Member of the Society of Arts during his stay, and may have his letters addressed to him at the Society's House in the Adelphi.

VI.—The Council will afford their advice and assistance to any Colonial Associated Institution which may desire to obtain in England or France any scientific or educational apparatus, and will obtain and furnish to any Colonial Associated Institution reports on any produce sent over for examination.

VII.—A Colonial Associated Institution shall have the privilege of purchasing books through the Society's agency on the same scale of reduction as is now granted to Home Associated Institutions.

VIII.—The system of examination proposed to be instituted by the Society of Arts shall be extended so as to embrace candidates who shall have duly attended classes at Colonial Associated Institutions, and Certificates of Merit shall be awarded by the Society's examiners on examination papers duly authenticated and remitted from the Colonies.

IX.—A Colonial Institution may be admitted into Union on the same terms as a Home Institution, namely, an annual payment of two guineas.

(By order,)

PETER LE NEVE FOSTER, M.A.,
Secretary.

Society's House, Adelphi, London,
19th Dec. 1855.

FIFTH ORDINARY MEETING.

WEDNESDAY, DECEMBER 19, 1855.

The Fifth Ordinary Meeting of the One Hundred and Second Session was held on Wednesday, the 19th inst., Joseph Glynn, Esq., F.R.S., in the chair.

The following candidates were balloted for and duly elected:—

Clarke, William
Gassiot, John Peter, F.R.S.
Pritchard, George

The following Institution has been taken into Union since the last announcement:—

406. London (Newington Causeway) Tailors' Labour Agency Literary Institute.

The paper read was:—

THE PRESENT POSITION OF THE IRON INDUSTRY OF GREAT BRITAIN, WITH REFERENCE TO THAT OF OTHER COUNTRIES.

By J. Kenyon Blackwell, F.G.S.

The civilised nations of the globe manifest at this epoch, in so marked a manner, tendencies to assimilate themselves and to approach each other, not only by their mental culture and their activity in the domains of thought, science, and art, but, in so far as their geographical position, their climates, and the resources of the lands they respectively occupy permit, to follow and rival each other in the same industrial and commercial pursuits, that it becomes evidently necessary for those of them who desire not to be left behind in this friendly rivalry, to take care that no valuable means of success are neglected on their own part.

It is, therefore, important in this point of view for all of us to take advantage of the opportunities afforded by those industrial, scientific, and artistic assemblages, such as that of the great French Exposition of this year, in order to examine our own resources and those of other nations, to compare their progress with our own, and to estimate correctly our present position and our future prospects; moreover, to do this in no unfriendly spirit of rivalry or jealousy, but with the full persuasion that the material resources of each of us are common property, and that the progress made in each art or science, and in the development of each branch of industry, will contribute to the common benefit of all.

The Great Exposition just closed in Paris, has confirmed and fully established the international character of these assemblages, and has given them a definite and permanent position, which they will continue to occupy in the future, after having already filled it with so much importance and success in the past.

The iron industry of Great Britain rests equally on her mineral resources, her geographical position, and the manu-

facturing and commercial activity of her community. We are all aware that it has reached a condition of great development and of economic importance. The quantity of iron made annually in this island alone is, nearly, if not quite, as large as the total of the quantities produced in other countries; the cost at which it is produced is lower, but it must be admitted that its quality is generally inferior to that of foreign iron.

Great Britain is not only the largest producer of iron, but at the same time both the largest consumer and the largest exporter of this metal. It is not only necessary to fulfil some important function in almost every art or industry, but it supplies the raw material for a great external commerce. It is indeed so universally necessary in its functions in arts and in industry, that some writers have taken its consumption in each country as a measure of their relative position among civilised communities.

The annual production of pig or crude iron appears, from a careful comparison of various authorities, to be at the present period nearly as follows:—

	Tons.
Great Britain	3,000,000
France	750,000
United States of America	750,000
Prussia	300,000
Austria	250,000
Belgium	200,000
Russia	200,000
Sweden	150,000
Various German States	100,000
Other Countries	300,000?
	6,000,000

It is proposed in the present paper to take first, a general view of the mineral resources of those countries which are the principal seats of the production of iron; secondly, to examine the nature of the various processes followed in this manufacture, and to inquire how far they appear to be susceptible of improvement; and lastly, to give some account of the evidences of progress in this industry abroad, as compared with this country, derived from the specimens exhibited at the Paris Exposition.

It will not be possible to bring the whole of these subjects within the limits of the paper read this evening. It will, therefore, terminate with the first part of this review. The other parts of the subject will be resumed at the earliest convenient opportunity.

The ores of iron, employed in the manufacture of that metal, may be divided into the following five great classes, namely, the magnetic oxides; the anhydrous hæmatites, including the micaceous and specular ores; the crystalline carbonates, or spathose ores; the earthy carbonates, under which great class must also be ranged the black-band carbonates; and lastly, the hydrated hæmatites and brown iron ores. This class will embrace the most modern deposits, or bog ores.

Iron is found in nature in other combinations; in the state of silicate, either alone or associated with magnesia, lime, or alumina; united with sulphur, phosphorus, or arsenic, and occasionally with other metals.

The above classes, however, embrace all those ores which are valuable in iron smelting. The iron in these ores exists in the state of oxide, mixed, to a greater or less extent, with earthy matter.

The magnetic oxides are found principally in the gneissose and other primary rocks. They occur in these formations both in veins, assuming the form of beds, conforming to the strike of the enclosing rocks, and in unconformable masses. These ores supply the great works of the Ural region in Russia, and those of Sweden. They are found in Norway and in Lapland. They also occur extensively in the primary region which stretches up the Atlantic coast of the United States through Virginia, Pennsylvania, New Jersey, Northern New York, Vermont, New Hampshire, and Maine. These ores are said to be largely developed in Nova Scotia; also on the southern side of Lake Superior, and in Missouri. They are met with in the Dartmoor region, in Cornwall. They are doubtless extensively found in numerous other localities, accompanying the older rocks throughout the globe.

In consequence of the association of the magnetic oxides with the primary formations, they are generally situated at a distance from coal. In the wild, forest-covered regions, where they often occur, the use of vegetable fuel in smelting, combined with the purity of these ores, enables iron of superior quality to be obtained from them.

The anhydrous hæmatites, including the compact and soft red oxides, and the specular and micaceous ores in which the oxide assumes its crystalline form, are found most abundantly in the transition formations. They are met with in veins and in irregular masses. They also frequently take the position of beds, the original constituents of which appear to have been removed, wholly, or in part, by those subsequent agencies which have introduced these ores. This species of ore is found in numerous localities in Great Britain, where it is met with chiefly in the carboniferous limestone. It occurs, however, in the Silurian and Devonian formations. Hæmatites, principally hydrated, from the carboniferous limestone, supply the Belgian works. They are found largely, chiefly of the anhydrous class, in the valleys of the Sieg, in Rhenish Prussia, and of the Lahn, in Nassau, where they occur in the Devonian formation. These ores are widely dispersed, especially in all those regions of the transition epoch in which igneous and metamorphic agencies have been prevalent. The immense deposits of iron ore in Elba, are of the class of specular ores. Hæmatites and specular ores are found largely in many parts of the United States. This class frequently ranks among the purest ores of iron.

The spathose ores, or crystalline carbonates of iron, appear to range through nearly the same series of formations as the anhydrous hæmatites. In England, they occur in the Devonians of South Somersetshire and North Devon, and in the carboniferous limestones of Northumberland. This class of ores forms the chief supply of most of the continental works occupied in the making of steel; of the works situated in the Austrian provinces of Styria, and Carinthia, in the Central Alps; of those situated on the Sieg, in Western Prussia; of those in the department of the Isère, in France; and in the province of Thuringia, in Prussia. These carbonates occur in veins and in masses. Where they have been long exposed to atmospheric influences, they are converted into hydrated hæmatites.

The magnetic oxides, the anhydrous hæmatites, and the crystalline anhydrous carbonates of iron, appear to have had their origin in the igneous agencies which, at periods subsequent to their first consolidation, have modified and introduced new mineral bodies, chiefly of the nature of metallic ores, amongst these rocks, both by the channels presented by the fissures formed by faults, and by the actual interpenetration of particular beds amongst them. In the latter case, one portion of the constituents of these rocks has been carried away and replaced by other bodies of a different nature. It is obvious that beds in which limestone forms the principal constituent, would lend themselves the most readily to this species of substitution.

The numerous and widely-dispersed regions in which the three preceding classes of iron ores occur, the immense masses in which they occasionally present themselves, and the great state of purity in which they are usually found, and the consequent facility in producing iron of excellent quality from them, would render them of the greatest value, and make them the principal sources of production, were it not that they are usually situated remote from mineral fuel. They are not developed to so great an extent in England as in other countries, and it is an interesting subject for inquiry, how far modifications in

the system of manufacture, combined with those improved means of communication and transport which are now being created in all civilised countries, may permit these classes of ores to assume a more important position in the production of iron than they now occupy.

The earthy or lithoid carbonates of iron form the next class enumerated. In these ores the carbonate of iron is mechanically mixed with variable quantities of clay or silicate of alumina, and of the carbonates of lime and magnesia. These earthy matters are sometimes partially, or nearly wholly, absent, and the carbonate of iron is found mixed with organic or coally matter. It then becomes what is technically called a black-band ironstone.

The earthy carbonates, which are evidently of sedimentary origin, are spread in courses of nodules, and in continuous beds, to a greater or less extent, throughout most of the more recent formations, from the coal measures upward. The black-bands, or carbonaceous lithoid carbonates, appear to be confined to the epoch in which coal was also formed in great abundance. These black-bands pass, by varieties having little difference from each other, into coal of the splint or cannel class.

The lithoid carbonates of iron are largely developed in the carboniferous formation, where they are found chiefly in courses of nodules. Their occurrence commences in some regions in the upper limestone shales, and they pass upward through the coal measures proper toward their higher limits. Lithoid carbonates also occur in thick and extensive beds in the Jurassic formation; near the upper limit of the lias, or base of the oolites proper; and again higher as nodules, and perhaps as beds in the middle oolites or Oxford clays. They are also found extensively as courses of nodules in the Wealden series, and as beds in the green sand.

These grey carbonates, particularly those of the Jurassic formation, in which lime is abundant, and clay or silicate of alumina is not largely present, are frequently changed by atmospheric influences, and perhaps, to even a larger extent, by a species of substitution somewhat analogous to that already alluded to, into hydrated peroxides or hæmatites. The immense deposits in the Jurassic formation are thus presented in some regions exclusively as hydrated hæmatites; for example, in Northamptonshire, and widely in France (where this species of ore forms the chief supply of the iron-works); while in Cleveland, where the same class of carbonates is found, but generally in deep valleys, under a thick covering of other strata, it exists as the unaltered grey earthy carbonate.

These stratified earthy ores of iron, in which this metal remains in the state of carbonate of protoxide, and those in which it has subsequently acquired the state of peroxide, appear to have had their origin in the mineral and probably thermal waters, which, at different epochs and through long periods, rose to the surface largely charged with carbonic acid, and thus holding iron, manganese, lime, and magnesia in solution. The probably elevated temperature of these waters would also cause them, independently of the carbonic acid which they contained, to bring with them other bodies in solution, such as silica and alumina, which they would deposit in cooling In some cases these waters would probably be discharged in localities covered with water, and their mineral constituents would be precipitated in a stratified form; they would fill the crevices and fissures, and would be deposited in cavities in the existing calcareous rocks, in which they would channel courses for themselves with the greatest facility. In other cases, they would form superficial masses of pisolitic or geodic structure, agglomerated around particular centres, and covered over by the superficial and local deposits at those points.

The local deposits of hydrated peroxides, covered up by clays and sands, in which the mineral has assumed the pisolitic form, or accumulated in large geodes, are probably due to the agency of such carbonated thermal waters. But another portion of the iron ores of the tertiary formations may have been brought into its present position by denuding agencies acting upon previously-existing beds of ore, which may have been swept away, rolled and spread over other formations posterior to those amongst which they were originally deposited.

The ores of iron used in the production of this metal rarely contain any other metal in large quantity except manganese. This metal is present to a small extent, namely, from $\frac{1}{2}$ to 1 per cent., in almost every known ore. This quantity rises in some of the best earthy carbonates or clay ironstones to 2 per cent. In the crystalline carbonates, which are esteemed of so much value, and are used so largely for the production of German or natural steel, the amount in which manganese exists rises frequently to 10 or 12 per cent. This metal being one possessing a high affinity for oxygen, its function and value in the metallurgical processes to which the iron with which it is associated is subjected, may rather be from its tendency to act as a flux in the state of oxide, which it readily acquires; and from its thus facilitating the removal, in the state of slag, of the other impurities contained by the iron with which it is associated, than from any peculiar quality which its presence as an alloy may confer.

Zinc is found in combination with the magnetic oxide of iron as Franklinite. The iron smelted from this species of ore possesses peculiar qualities of ductility.

Slight traces of other metallic bodies are sometimes found in the common ores used for smelting, such as tin, lead, copper, bismuth, nickel, titanium, arsenic; but the quantities in which they generally exist are so minute that it seems questionable whether they exert any sensible effect on the quality of the iron with which they pass through the smelting furnace.

Many ores, particularly the earthy carbonates of the coal measures, contain small quantities of sulphur, in the state of iron pyrites, disseminated mechanically through them.

The earthy carbonates, the black-band carbonates, and the hydrated peroxides, or altered carbonates of the Jurassic series, contain phosphoric acid, probably in the state of phosphate of lime or magnesia. Few of the ores of these classes contain less than $\frac{1}{2}$ per cent. of phosphoric acid. In some of the earthy carbonates of the coal measures, this quantity rises to $\frac{3}{4}$ per cent.; but the iron which some ironstones containing this proportion of phosphoric acid produce, is found to be of the best quality; and, contrary to generally received opinions, is not cold-short. In some varieties of black-band carbonates, the quantity of phosphoric acid, large in all cases, rises to $1\frac{1}{2}$ per cent. The grey carbonates and altered hæmatites of the Jurassic series, contain this acid in large proportions, varying from $1\frac{1}{2}$ to 2, and in some cases, to 3 per cent. The hæmatites of this class make, nevertheless, red-short, while the black-band carbonates make cold-short iron. These hæmatites contain little or no sulphur.

The magnetic oxides, the anhydrous hæmatites, and the crystalline or spathose carbonates are, as classes, the purest of iron ores. They contain little earthy matter, in many cases little silica, and scarcely any alumina, lime, or magnesia. They generally afford minute traces only of sulphur or of phosphoric acid. As a class, however, these ores have a tendency to produce red-short iron.

It will be observed from the preceding facts, how little is yet known of the conditions which produce the distinctive qualities of iron manufactured from ores of different classes, and what a wide field for investigation on this subject yet remains open.

The immense production of iron in Great Britain rests, in the first place, upon the almost inexhaustible supplies of mineral fuel, furnished so largely and so cheaply by her numerous coal-fields; and secondly, almost in an equal degree, on the abundance of ores of earthy, or of black-band carbonates, which, in most of those coal-fields, are interstratified with this mineral fuel.

The only great coal-fields in Great Britain in which these ores, although not entirely wanting, do not occur in sufficient abundance to form the basis of a large production of iron, are those of Northumberland and Durham, and of Lancashire. The immense beds of grey earthy carbonates which are found in the Jurassic formation of North Yorkshire, now brought by railroads into close proximity to the first of these coal-fields, has already laid the foundation for an immense production of iron in the first of these districts. The ores of North Lancashire and of Cumberland might be brought with advantage to be smelted in the latter. In two of the other smaller coal-fields, namely, those of Cumberland and of West Gloucestershire, in which the carbonates of the coal-measures do not occur abundantly, the hæmatites, which exist in the subjacent carboniferous limestones, supply their place, and are raised in sufficient abundance, not only to be smelted in the localities in which they are raised, but also to be transported in large quantities, to the other principal coal-fields of Great Britain, for mixture with their clay ironstones.

About four-fifths of the iron produced in Great Britain is made, in nearly equal proportions, in the three great districts of South Wales, South Staffordshire, and Scotland. Northumberland and Durham follow next in respect to quantity; and then Yorkshire and Derbyshire, Shropshire, North Staffordshire, North Wales, Cumberland, and Gloucestershire complete the list.

The production of South Wales is still capable of large augmentation. It rests principally on the clay ironstones of the coal field. Black-band carbonates are also found in some situations in this basin. The position of the Welsh iron works permits the hæmatites of Lancashire, Cumberland, Cornwall, and the Forest of Dean, to be brought to them advantageously for smelting with their clay ironstones. Recent discoveries in Somersetshire and North Devonshire, of crystalline or spathose carbonates of iron, are likely to add another valuable class of ore to those now imported into the South Wales district.

The explored field of South Staffordshire, so rich in coal and clay-ironstones, of excellent quality for the production of iron, is, from its limited extent, compared with its immense production, progressing rapidly towards exhaustion. This coal-field appears, however, to be only an isolated portion of a much greater field, of which detached parts show themselves, rising from beneath the new red sandstone of the Midland counties, from Shropshire on the west, across Staffordshire and Warwickshire, to the Leicestershire coal-fields on the east; and the northern prolongations of which may even prove to be continued, beneath the new red sandstone, through North Staffordshire, into Lancashire and North Wales on the west, and into the coal-fields of Nottinghamshire and Derbyshire on the east. The existence of coal, at an attainable depth, beneath the new red sandstone measures of this wide region, is the most important problem which exists for solution with reference to the future mineral resources of Great Britain.

The iron produced in Scotland is, at the present period, almost exclusively derived from the rich and cheaply-worked black-band carbonates of that great coal-field; but as these are exhausted, they may be replaced by the deposits of clay ironstone, which (although now little worked, on account of their somewhat greater cost,) exist, nevertheless, in great abundance, in the lower part of the carboniferous series of this region.

The abundant supply obtained from the cheaply-worked black-band carbonates of this coal-field, has hitherto prevented the use of imported ores at the iron works situated in it, except in very small quantities. But this great coal-field, open on its eastern and western sides to two seas, and traversed throughout its extent by great rivers, canals, and railways, is well situated for the introduction of foreign ores, if needed, at its works. The black-band carbonates recently found in the north of Ireland, are now being worked for transport to Scotland. The hæmatite ores of Cumberland and Lancashire might also be brought to the Scotch works, with at least equal facility as to the works of other districts in which they are so largely used. The immense deposits of clay carbonates in the lias of North Yorkshire, might be conveyed to the works on the eastern coast of Scotland at low freights. If the existing prohibition to the export of ores from the great deposits of magnetic oxide, found so extensively in Sweden, Norway, and Lapland, should be removed, ores from these countries, and especially from Arendal, in Norway, might probably be brought advantageously into Scotland to be smelted.

The production of iron in Northumberland and Durham, rests almost entirely on the great beds of earthy carbonates, the nature of which has already been described, which exist in the upper lias measures of North Yorkshire. There are also, in close proximity to this coal-field, on its western side, valuable ores of crystalline or spathose carbonates, which occur in veins (frequently associated with galena and with calamine) situated in the carboniferous limestone lying under the coal series. The upper edges of these veins are generally changed, to a greater or less extent, into hydrated hæmatites. A part of the supply of one of the great ironworks of this district is now obtained from this class of ores, but from the very low cost at which the lias ores can be got to an almost unlimited extent, they will probably form in future the principal source of the already great and rapidly advancing make of this region, which is, no doubt, destined to take a prominent rank among the iron districts of Great Britain, as regards the amount of its production.

The quantity of iron smelted in Yorkshire and Derbyshire will probably increase. This is one of our most important coal-fields, the limits of which to the eastward are yet quite unknown. It runs throughout its whole extent, nearly parallel and sufficiently contiguous to the great liassic ore beds of North Yorkshire, Lincolnshire, Leicestershire, and Northamptonshire, to permit the introduction of these ores for admixture, at any of its works, with the clay carbonates of the coal measures with which its coal-field abounds.

The coal-field of North Staffordshire is very rich in its aggregate thickness of coal, but it is chiefly remarkable for the immense deposits of black-band carbonates which it contains. The numerous varieties of these iron ores, varying from the clay carbonate into the almost purely carbonaceous carbonate, which it contains, afford supplies not only to the iron works situated in this district, but are also largely exported into South Staffordshire and into North Wales.

The only blast furnaces in Great Britain which now exist in which the ores are smelted with charcoal, are the furnaces of the Newland Iron Company, situated near Ulverstone, in Lancashire, and at Bunawe, in the district of Lorn, in Argyllshire. These furnaces are supplied by the hæmatite ores of Ulverstone. They produce about 2000 tons annually of charcoal pig iron from one furnace blown in each district. This pig iron is converted into bar iron for steel, or sold to ironfounders, who make small castings, in which much tenacity and some degree of malleability is required, under the name of malleable pig iron. This quality of malleability is developed in it by annealing.

The preceding remarks have been directed to the subject of the future prospects of the iron industry in this country, particularly with reference to those circumstances on which the probability of its future permanence, its increase, or its contraction depend. The question as to the existence of any neglected resources for the production of iron which may exist in this country, therefore, arises in this place. In Great Britain the most favourable localities are undoubtedly already very fully occupied; but in Ireland there exist immense deposits of clay carbonates of excellent quality, which are now entirely unworked, probably on account of the small extent to which mineral fuel exists in proximity to these deposits. These deposits

were formerly largely worked when the districts where they occur were covered with wood. It is a very important subject for inquiry, whether the immense resources of vegetable fuel, in the form of peat, with which Ireland abounds, and nowhere to a greater extent than in Eastern Connaught, the region in which these ores exist so largely, might not be advantageously applied to the production of iron of first-rate quality from them. Pig iron is smelted with carbonised peat in Bohemia.

The production of iron in France rests almost entirely on the widely-extended deposits of ore which exist in the Jurassic formation of that country. These ores are various in character. They are found stratified in beds, and in accumulated masses in the form of grains, of kidney-shaped concretions and of geodes, in cavities of the limestone of this formation, or lying upon them superficially. They are met with in the state of grey earthy carbonates and in that of hydrated peroxides. Many of these deposits are merely superficial, and only covered by the diluvial clays and sands. These hydrated ores, resulting probably in many instances from the destruction and re-collection of the Jurassic beds, extend upwards into the tertiary formations. They are found lying upon the latter, in many places, in the three northern departments of the Nord, the Pas de Calais, and the Ardennes.

The ores of the Jurassic series which appear to accompany the upper members of the lias and the Oxford clays, follow the range of these members of the Jurassic formation from the north and north-east, southwards through the departments of the Ardennes, Meuse, Moselle, Haute Marne, Haute Saône, Côte d'Or, through the department of the Yonne, to those of the Nièvre, Cher, and Saône-et-Loire, in Central France. The ores of the Jurassic formation are also found largely in the eastern departments of the Jura and Isère; in the south-east and south, in the departments of the Ardêche, the Gard, and the Aveyron, and again in the south-western department of the Dordogne.

The clay carbonates of the coal-measures are only found of sufficient value to work in three localities,—in the coal-fields of the Gard, of the Aveyron, and, to a very limited extent, in the coal-field of the Loire, near St. Etienne. The anhydrous peroxides and crystalline carbonates of iron are only worked at present in small quantities.

The ores of iron are disseminated to a greater or less extent over so great a part of France, that they are worked, more or less, in nearly 60 departments; but those whose names have been enumerated supply by far the largest quantities. Their production amounts to six-sevenths of the total quantity raised. This total quantity is about 3,500,000 tons, which is, however, reduced by the process of washing, which the bulk of the peroxides undergo previous to being smelted, to less than one-half of the above weight.

The ores from the Jurassic series, from the greensand, and from the superficial accumulations of peroxide, by which the consumption of the French iron-works is almost entirely supplied, are mined at a very low rate. Even when the expenses of washing and of conveyance to the works at which they are smelted is added, their cost remains low.

The smelting of the ore, and the subsequent processes of manufacture, are still carried on to a large extent in France with charcoal. Much of the ore is mined in districts which have hitherto remained without sufficient means of communication with the numerous coal-fields which exist in France. Water navigation has supplied the means in a few localities only to bring the ores to the coal by which they could be smelted, and to connect these points with the large markets. Still the advantages of carrying on a part, if not the whole, of the processes of the iron manufacture with mineral fuel, is causing iron-works gradually to spring up in all those coal-fields from which a cheap supply of good coal can be obtained; and, at the same time, the great net-work of internal communication, which the admirably arranged and complete system of railroads is now affording to all parts of France, will enable the great bulk of these ores, or the charcoal pig-iron into which they will probably continue to be converted in remote and thickly-wooded districts, to be concentrated in these coal-fields, either for smelting, or for conversion into bar-iron, according as the one or the other can be effected with the best results.

Coal is found in France in numerous and widely-distributed localities. The number of distinct coal-fields amounts to about thirty. As many of these exist, however, under conditions which lead to the conclusion, that they are only the exposed edges of larger coal-fields, the prolongations of which may hereafter be found to meet under those more recent formations which cover up the coal-measures in the direction of their dip, the number of separate fields will probably be eventually reduced, while the area which the coal-formation is now supposed to occupy may be greatly enlarged.

The area occupied by the coal-formation in France, so far as its limits have been hitherto ascertained, amounts to about 100 square miles, or 650,000 acres. This extent is not quite equal to one-fifth of the ascertained area in Great Britain; but many of the coal-fields of France, particularly those of the central and southern departments, contain seams of such enormous thickness, that the quantities of coal yielded by them will be much greater than can be obtained from an equal area in our own coal-fields.

The largest known coal-field in France is the Northern. This forms the continuation westward of the great Belgian basin. This great field, one of the most interesting in Europe, in a geological point of view, is probably prolonged under the tertiary measures of Northern France to the coast near Calais, where coal-measures rise to the surface; and it may not improbably be ultimately traced westward across the Channel, in continuous or detached portions, beneath more recent deposits, until it may be found to be united with our Somersetshire basin. This great field, broken across at Namur, and separated into three small isolated basins at its eastern termination, near Aix-la-Chapelle, follows the north-western flank of that great mass of transition strata through which the Rhine breaks its way above Cologne, to the east of which river the coal-measures again emerge, occupying the same position on the flank of this group of transition strata, in the valley of the Ruhr, in Rhenish Prussia.

In the northern departments of the Pas de Calais, the Nord, and the Ardennes, a large quantity of iron is smelted with coke from this northern coal-field, and the ores of the tertiary deposits of this region. The principal works are Marquise, Denain, and Anzin, on the north, and Mezières on the south of this great basin.

The great coal-field of Saarbruck, situated on the south-east flank of the same group of transition strata as that just alluded to, is certainly prolonged into France across the Prussian frontier towards the Moselle, near Metz. This is one of the districts which are the richest in iron ore in France; and this great coal-field, when explored and worked under the newer formations by which it is covered in this region, is undoubtedly destined to become one of the great centres of the iron industry of France. Iron smelted with coke is already produced to a large extent in the department of the Moselle, near Metz, at the works at Thionville, Briey, and Hayange.

The canals and railways now in existence or in construction in this region, which will link together all its great river valleys, (those of the Marne, the Meuse, the Moselle, and the Rhine,) will give all the facilities required in addition to its mineral wealth to make it a great iron producing country.

Passing to the southward, the next important coal-fields in the eastern departments are those of the Saône-et Loire; these are that of Epinac, or Autun; and those of Creuzot and Blanzy; the two latter forming parts only of the same basin.

The southern coal basin of Saône-et-Loire, in which Creuzot is situated, is traversed by that great system of water navigation which, by means of numerous canals, connects the Rhine, the Saône, and the Rhone, with the Seine, the Loire, and the Cher; and the arteries of which traverse a great part of the most important iron ore deposits of France. Creuzot, from possessing these advantages, was early selected as one of the most advantageous sites for large iron works, at which mineral fuel might be applied either in smelting, or in the subsequent processes of iron manufacture, for the conversion of the pig iron smelted with charcoal. This district will no doubt retain its already acquired importance, as one of the great centres of production, which its mineral resources and its geographical position have already marked out for it.

Continuing westward along the northern edge of the great central granitic plateau of France, near one of the points of convergence of this ramified system of water communication, where the Yonne, one of the tributaries of the Seine, is connected with the Loire, is situated the coal-field of Decize, in the department Nièvre. The limits of this field are not yet known. It is surrounded and covered at its edges by more recent formations. The iron works of Fourchambault are in this district.

Near the last-mentioned field, to the southward, lie a great number of coal basins, scattered irregularly over the central granitic table-land of France, some of which contain thick and valuable coal seams. In the department of the Allier, near the head of the Cher, lying between that river and the Allier, we find the coal basin of Commentry, and several others which are grouped near it. These basins furnish coal to the iron works of Commentry, Montluçon, Vierzon, in the department of the Cher, and to others which are connected by the ramified water communication already mentioned, with the rich ore deposits of the department of the Cher, and of the Nièvre.

It will be impossible within the limits of the present paper to enumerate all the coal-basins scattered over this central plateau of France. Those only which have, or are likely to take, an important position in the iron industry of France will be adverted to.

Continuing southward down the course of the Rhone in the department of the Loire, we find the great coal-basin of St. Etienne and Rive de Gier, which is one of the richest and so far as yet known, one of the most extensive in France. The clay carbonates of iron, sparingly distributed in the coal-fields of France, but so abundant in England, are found and worked to some extent near St. Etienne. Blast furnaces supplied with coal as fuel, have long existed in and near this coal-basin, but it is not so favourably situated for supplies of iron ore as the coal-fields of the Saône-et-Loire, and of the Allier already alluded to. The principal works in the coal-field of the Loire, are those of Terre Noire and l'Horme.

Passing southward from the basin of the Loire, and then continuing westward along the limits of the central primary plateau, we find the coal field of the Ardêche, and, again, further to the south-west, the important field in the department of the Gard, near Alais; while further westward in a great bay of the primary strata, are situated the coal-fields of Aubin and Decazeville, in the department of the Aveyron; the latter, like that of the Gard, dipping eastward until covered up by the more recent strata which skirt this granitic plateau.

The coal measures rise to the surface at many points in this region near the line where the more recent formations skirt the granitic plateau. They are exposed extensively at St. Gervais, and also at Ronjon in the department of the Herault. They are also met with at several points on the western flanks of this plateau, in the department of Correze, where they are in proximity to the Jurassic and tertiary iron ores of the Dordogne. These facts have an important bearing on the question with reference to the extent to which the coal measures of southern France may probably be eventually found to be developed beneath the Triassic, Jurassic, and Tertiary measures of that region.

The coal-fields of the southern departments of France, and in particular that of Aubin and Decazville, are very rich in coal. They also contain, or are in proximity to, valuable iron ores. It is highly probable that their present supposed limits will receive great extension from future explorations. They have, probably, been hitherto prevented from taking that position as iron-producing districts, which they are likely at a future period to occupy, from want of good and cheap communication with the great markets in France. These means of communication are, however, now being supplied.

There are already important iron works at La Voulte, in the department of the Ardêche, at Bességе and Alais, in that of the Gard, and at Aubin and Decazeville, in that of the Aveyron, in which coal is used for smelting.

The iron produced in France is smelted in nearly equal proportions with coke and with charcoal; and a large part of this charcoal pig iron is subsequently converted into bar iron solely with charcoal. The departments in which this production is by far the greatest, in consequence of the abundant supply of ores, (chiefly from the Jurassic formation), and the wooded nature of the regions where these ores are found, are, commencing to the north, those of the Ardennes, the Meuse, the Moselle, the Haute Marne, the Côte d'Or, the Haute Saône, the Cher, and, passing into the south-west, the Dordogne. The great production of charcoal pig iron is therefore in regions in close proximity to some of the most important coal fields of France. This circumstance, when the communications of the country become more perfect, will no doubt lead to a more complete, as it has already led to a partial, transformation of this branch of industry. The coal-fields will become the great centres of the manufacture of iron, to which either the charcoal pig iron, still produced in the regions where ores and vegetable fuel are abundant, will be conveyed for subsequent elaboration; or to which the charcoal supplied by these wooded regions will be brought, to be there applied in the conversion into wrought-iron, of the pig iron smelted with coke; whenever a superior quality of this metal is required.

So long, therefore, as large tracts in these eastern departments, in which the ores of iron are found so abundantly, continue to be thickly covered with wood, iron will be smelted in the localities where the ores occur with charcoal; but coal being a superior fuel to wood for many of the subsequent processes of elaboration, this pig iron will subsequently be conveyed to the nearest coal-fields for manufacturing into bar iron. When, however, the supplies of charcoal diminish in these regions, and the lines of communication become more perfect, the ores themselves will be all carried to the coal-fields for smelting, and the charcoal necessary for after-working, will also be conveyed to these great centres of manufacture.

The production of iron in Belgium rests on the abundant supply of valuable hæmatite ores, derived from the carboniferous limestones which form the base of the coal measures; and which are therefore obtained in proximity to the mineral fuel furnished by the great coal basin which traverses the Belgian territory in almost unbroken continuity from east to west. Some pig iron is still smelted, in the wooded region of the Ardennes with charcoal, for the purpose of conversion into wrought iron of superior quality. From the limited extent of this country, the production of iron will, in all probability, remain nearly stationary.

The production of iron in Prussia stands next to that of France among the European States. It is rapidly increasing. The resources of the Prussian States in iron ore and in mineral fuel are large. The great obstacles to the development of iron industry in this country appear to be, from the nature of her widely-spread and ill-connected territories, and from the want of facilities of intercommunication and access to large markets.

The great coal field of the Ruhr, in Westphalia, contains numerous coal-seams of good quality. It has been discovered during the last few years that there also exist in this coal-field, valuable strata of clay carbonates, and of black-band carbonates of iron, inter-stratified with the coal measures. The Ruhr, a navigable river, except when impeded by ice in the winter, traverses this coal-field and debouches into the Rhine at Ruhrort, the point where the state railway (connecting this region with Berlin, and traversing this coal-field north of and parallel to the Ruhr) strikes the Rhine and turns southward to Cologne.

This region bordering on the Rhine contains other iron ores of excellent quality in large quantities, especially in the valley of the Sieg, in the Prussian territory, and in that of the Lahn, in Nassau. These ores, which are principally of the classes of anhydrous hæmatites, and of spathose carbonates, can be conveyed at a low cost by the Rhine, to meet the coals of the Ruhr coal-field at Ruhrort, or can be sent into the coal-field itself by the Ruhr, if required for smelting there with the ores of the coal formation.

The northern boundary of this great coal-field has not yet been determined. The coal strata continue beyond the limits yet explored beneath the measures of the chalk series which cover them, and beneath which they are worked on that side. It is an important consideration to what extent they may be prolonged in that direction.

All circumstances concur to render it probable that the region in which this coal-field is situated will become an important centre of production for iron. Close to the Rhine and its great markets, the abundant supplies of coal and ore of excellent quality, which exist in this region, may be concentrated at those points where works are erected. The supply of ores will only be limited by the demand, and the cost of ores and of mineral fuel will be low. There is already a large industrial population in the region, workers in iron and in steel. Many large iron works are now rising in or near this coal-field.

The most valuable portion of the coal-field of Saarbruck, is that which borders on the French frontier, and which is the furthest removed from the Rhine. It is the proximity to this coal-field in France, of the iron ores so abundant in the departments of the Moselle, the Meuse, and the Ardennes, which renders it probable that the coal deposits in the western part of this great field will be largely used in iron making; but those iron ores being in France and not in Prussia, it does not appear probable that this coal-field will occupy the same position in the latter country. Some iron is, however, produced in the valley of the Saar, which traverses the western part of this coal basin.

Prussia possesses, however, on its eastern frontier, in Upper Silesia, near the head waters of the Oder and of the Vistula, great coal-fields, which are in the vicinity of important deposits of iron ore. The iron ores of this region are chiefly hydrated peroxides, occuring extensively in the muschelkalk which covers and surrounds these coal-fields toward their dip. These hydrated peroxides are situated in a different geological position to the iron ores of Belgium; at the same time they possess interesting points both of analogy and of contrast to them, being in both cases associated with large deposits of calamine, occuring under similar circumstances, but in different formations; these ores being found in the muschelkalk in Upper Silesia, while in Belgium the position of all these associated ores is in the carboniferous limestone.

The yield in iron of these hydrated peroxides in Upper Silesia is very low, from the quantity of earthy matter with which the ore is mixed, and which (from the fineness and lightness of the ore) it has not yet been found possible to separate by washing. The extent of these deposits, and the low cost at which they can be worked, counterbalance this disadvantage. The ore and coal in this region have hitherto been worked at some distance from each other, but it is probable that both will be eventually brought into immediate proximity by sinking through the muschelkalk, in which the ore beds occur, to the coal measures which lie beneath.

The clay ironstones of the coal measures are not largely developed in this region. In Northern Silesia, however, there are valuable ores of clay carbonates of iron in the transition formations, which are now smelted with wood, on account of the region in which they are found lying distant from these great coal-fields.

Prussia also possesses valuable ores of iron in other districts of her territory. Those of Thuringia have been long celebrated for the steel produced from them. The great development which may be anticipated in her iron industry, will probably take place principally in the large coal regions of the Ruhr and of Upper Silesia. The rate and scale of this development will depend in a great degree on the perfecting of her internal lines of communication, especially of those required within the great ore and coal-fields.

The iron industry of Austria is spread over nearly all the widely-dispersed provinces of that empire. The largest production is in Styria and Carinthia, from the great and valuable deposits of spathose carbonates of iron which exist in those regions of the Central Alps. This forest-covered land, traversed by numerous streams, will no doubt long continue to be a country in which iron, of superior quality, both from the nature of the ores from which it is obtained, and from being smelted and worked with charcoal, will be produced to a large extent.

Iron is made to a considerable extent in Bohemia. It is there obtained from several species of ore. Although Bohemia possesses large and important coal-fields, both of the carboniferous epoch, and also of the tertiary age, the iron produced in that region is still smelted and workod with charcoal or with turf. This is probably caused by the want of lines of intercommunication to facilitate the concentration of the ores in those parts of this region where large stores of valuable mineral fuel exist.

Scattered iron works also exist in Moravia and Silesia, in which ores of various species are used with charcoal as fuel. There is also a large production of iron in the Carpathian region, in Hungary. The forests which cover these regions will, probably, long maintain this species of production, or even enable it to be augmented.

In Russia and in Sweden, notwithstanding the abundance of valuable ores which exist, the absence of mineral fuel must prevent any great extension of the iron industry. The production of these countries will, therefore, remain comparatively stationary. The great deposits of ore in the latter country, might probably be rendered much more valuable, if the laws prohibiting its export were repealed.

The make of iron in Spain is very small. The process almost universally employed is of the rudest class. There are, however, in Spain, valuable mineral resources for the production of iron. The ores of Biscay, Catalonia, Arragon, Granada, and the coal-fields of the Asturias, Leon, and Andalusia, will probably, at some period, become the sources of important production.

The iron industry of the United States is already highly important, and is capable of great extension.

Iron ores of various classes are largely and widely developed in this country. Magnetic oxides accompany the primary formations which skirt the Atlantic coast, and follow them in their western prolongation through the region of the great lakes. Anhydrous hæmatites occur extensively in the Silurian and Devonian formations. Clay carbonates (frequently changed into hydrated peroxides) occur near the base of the carboniferous series in some localities, and sparingly also in the coal measures themselves, as, for example, in the Maryland coal basin, and near Hanging Rock in Ohio, in the great western Pennsylvanian field. This class of ores has not, however, hitherto been found abundantly either in the anthracite coal-fields east of the Alleghanies, or in the three great bituminous coal-fields situated in the Mississippi Valley, west of that range of mountains, that is in the great coal regions of

Western Pennsylvania, Virginia, and Ohio, of Illinois, or of Missouri and Arkansas. But these enormous carboniferous regions have hitherto been so imperfectly explored, that we do not know with certainty to what extent these ores may hereafter be found to exist in them. Hydrated peroxides form one of the most abundant and widely-dispersed ores of iron in the United States. They are found not only as changed carbonates, but independently, in large accumulations of geodes, covered by the superficial clays resting on the Silurian, Devonian, and carboniferous formations. These superficial deposits form one of the principal sources of supply to the iron works, both on the east and on the west of the Alleghany mountains.

The three great anthracite coal basins situated in Eastern Pennsylvania, (commonly called the northern, middle, and southern basins, from their relative position,) and the bituminous coal basin situated near Cumberland, in the State of Maryland, form the principal sources of mineral fuel in the Atlantic region. There are also, however, several small patches of semi-anthracite coal in Northern Pennsylvania.

West of the Alleghanies are found the three immense bituminous coal-fields already enumerated. The coal formation covers a large tract in Michigan, but no productive coal measures have yet been found in this region.

In the coal-fields west of the Alleghanies, the aggregate thickness of coal is, however, small, as compared with most of our European fields, but the superficial extent which they occupy is enormous. In Great Britain the average thickness of workable coal may be about 30 feet. In Southern France it is probably 100 feet. In the anthracite basins of Eastern Pennsylvania it may be, perhaps, 50 feet. In the coal-fields of the United States west of the Alleghanies, it is doubtful whether the aggregate thickness of valuable coal will average so much as 10 feet.

In the United States, the forests which formerly covered the whole of the region west of the Missisippi river, are beginning to disappear on the eastern side of the Alleghanies. In this last mentioned part of this country, the smelting and manufacture of iron are now carried on, almost exclusively, with mineral fuel. Anthracite coal is used at all the large works in New England, New York, New Jersey, and Eastern Pennsylvania, for puddling and rolling iron. In southern New York, and eastern Pennsylvania, it is used for smelting. The bituminous coal of the Maryland basin is used for smelting, puddling, and rolling at the works situated in that coal-field. West of the Alleghanies, the whole of the iron made is still smelted exclusively with charcoal, or to a small extent, worked into blooms with it by the Catalan process. The whole of the iron made throughout this region is, however, concentrated in the coal-fields at the points nearest to its origin, such as Pittsburgh, or Wheeling, which are found to be most convenient for its conversion into wrought iron with bituminous coal.

The extent of the production of iron in the United States is, therefore, a question to be determined in a great degree by the available means of transport; that is, by the facility with which the ores of iron can be brought into proximity to fuel. With modern means of conveyance, those distances hitherto considered insurmountable may no longer be found sufficient to impede and limit production. The immense coal-fields of this country may also be found to be, in their western parts, more productive in carbonates of iron than they are in those regions where they have hitherto been fully explored.

The districts in which iron is now produced in the United States, may be divided into those of New England, Eastern New York, Eastern Pennsylvania, and Maryland, the whole of which are situated on the east of the Alleghany range; and west of this range, into Western Pennsylvania; Western Virginia and Ohio; Tennessee; and Missouri, Illinois and Wisconsin will no doubt also soon take a position as iron-producing districts.

In New England the whole of the iron produced is smelted with charcoal. There are rolling mills at Providence and Boston, in which coal is used for puddling and rolling. The New England works are not so well situated as those in Eastern New York, and in Pennsylvania, which are connected by railways and canal navigation with the great anthracite coal basins situated in the eastern part of the latter State.

That part of the State of New York in which iron ores are found most abundantly, is situated near Lake Champlain, at the head of the Hudson River. The great deposits of magnetic oxide found in that region are either smelted where they are raised, with charcoal; or are conveyed by the Hudson to the point where the Delaware and Hudson Canal meets that river, near Newburgh, and thus brings to that point supplies of coal from the Lackawanna region of the northern anthracite coal-field, which are there used for their smelting.

In Eastern Pennsylvannia, which is the great seat of the manufacture of iron with anthracite coal, the works are scattered in several groups. The works of this region may be sub-divided, first, into the Easton group, situated on the Lehigh, at Easton and at Allentown; this group is supplied with iron ore in part from the great magnetic oxide deposits of north-western New Jersey, and in part from the hydrated hæmatites found in great masses of geodes, covered by the surface clays resting on the Silurian limestones of the district in which the works are situated, and with coal from the southern anthracite coal basin. Secondly, another part of these works constitutes the Danville group, which, commencing at the Scranton Works, near Carbondale, on the Lackawanna, continue at intervals through and beyond the limits of the northern anthracite coal-field by Danville, to the neighbourhood of Northumberland. These works derive their supply of ore from the beds of hæmatite found in or lying upon the limestones of the Silurian epoch, which rise to the surface to the north-west of the coal-field in or near which these works are situated. The Scranton Works obtain, however, their supply of ore chiefly from beds of clay carbonates lying below the coal formation. Thirdly, another group is found near the south-eastern extremity of the State of Pennsylvania, formed by the works at Reading, at Phœnixville, and at Safe Harbour, which are supplied with ores principally from deposits of hydrated hæmatites occuring in the surface clays of that region (similar in character to those of the Easton district), and partly from magnetic oxides met with in various localities; the anthracite coal used for smelting and conversion at these works being brought from one or more of the three great anthracite coal-fields of Eastern Pennsylvania by the Reading Railway, the Schuylkill Canal, or the Susquehanna River.

The remaining works situated to the east of the Alleghany range are those of Maryland; part of these are found in the wooded and mountainous region through which the Potomac flows; they smelt the hæmatites of this region with charcoal; the others are situated in the Maryland coal-field. This basin, the only considerable bituminous coal-field on the Atlantic States, is situated not far from the head of the Potomac river. The latter works are supplied partly with ore from the clay ironstones of this coal-field, and partly with hæmatite ores found in the limestones of the Silurian epoch, near Cumberland, and on the Potomac, at some distance from the coal-field.

To the west of the Alleghany range, the iron made is, as already observed, still smelted exclusively with charcoal; but it is afterwards conveyed to the nearest and most convenient points in the great Pennsylvanian bituminous coalfield, lying on the west of this great range of mountains, for conversion with mineral fuel. The principal districts in which the pig-iron of the region is produced, are first the northern district, or that of Western Pennsylvania, which embraces the upper courses of the Alleghany, Juniata, and other rivers meeting in the Ohio at Pittsburgh. In this district the ores chiefly used are hydrated

peroxides, from the strata at the base of or below the coal formation. Secondly, that of Hanging Rock, in Ohio and Western Virginia. The ores of this district, which is situated on the south-western edge of the great Pennsylvanian bituminous coal field are clay carbonates associated with the coal measures and superficial accumulations of peroxides. These ores are smelted with charcoal. Thirdly, the district of Western Tennessee. In this district valuable hæmatite ores are extensively found in the Devonian formation. They are smelted or converted into blooms by the Catalan process with charcoal in the region where they occur.

Iron works are now being established in Missouri, near St. Louis, in the neighbourhood of the enormous deposits of magnetic oxides and specular iron ores which exist in that region. These works, to which the ores will be brought by railroad, will be situated on the edge of the great Illinois bituminous coal-field. It may likewise be expected that important ironworks will also spring up on or near the northern edge of this coal-field, to which the immense deposits of magnetic oxides existing on the shores of Lake Superior will be brought for smelting or for manufacture after being smelted by charcoal in the regions where they are found.

A brief discussion, in which Mr. Fairbairn, F.R.S., Dr. Percy, F.R.S., Mr. Warrington Smyth, F.R.S., Mr. W. Bird, Mr. Joseph Freeman, Mr. R. F. Davis, and the Chairman, took part, followed the reading of this portion of Mr. Blackwell's paper; but as it had reference more particularly to the manufacturing part of the subject, it is considered advisable not to publish any of the remarks until the paper is completed.

The evening of Wednesday, January 9th, has been fixed for the reception of the second part of Mr. Blackwell's paper. An *extra* meeting will therefore be held on that day at the usual hour.

The Secretary announced that there would be an Extra-Ordinary Meeting on the evening of Friday next, the 21st inst., (this day,) for the purpose of renewing the Discussion upon Mr. Bailey Denton's paper "On the Under-drainage of Land."

For the arrangements after Christmas, members are referred to the Society's advertisement, on the front page.

INDIAN FIBRES.

The following remarks, on the collection of Indian fibres exhibited by Mr. Thomas Watson, at the Society's meeting on the 12th of December, are drawn from a letter which that gentleman forwarded to the Secretary. He observes, in the first place, that the majority have, he believes, already been brought to the notice of the Society by Dr. Royle, but still he thinks there are some which have not been previously exhibited in this country. He distinctly wishes it to be understood, that the present collection is not put foward as representing the entire of the fibres of India, as many most important ones, of the hemp family, as well as several others, are omitted. He says:—

"To commence, then, with the rougher and least interesting samples of the basts. These are from Arracan, and were furnished to the Agri-Horticultural Society of India by Lieut. P. W. Ripley, Assistant-Commissioner at that place. With one exception, they are certainly little fitted for home consumption, being coarse and inflexible, but the excepted sample, under improved preparation might very probably meet a market here, provided it could be supplied in sufficient quantity and at a moderate price, but these data Lieut. Ripley has not furnished. Accompanying these basts, the same contributor forwarded the inner barks of several large trees, one of which is among the specimens. My reason for drawing the attention of the Society to this article is, that from the absence of the outer skin, or epidermis, and the open reticulated state of this inner bark, it would appear that the natives of this place have a method of steeping or retting trees in a similar way to what we do flax.

"There is a small piece of a very delicate bast I discovered in a wild jungle tree, called the Noona, just previous to my leaving India. This tree is found all round Calcutta, in large quantities, is a rapid grower, and yields the bast with little trouble, and I think it likely it may be turned to some account.

"From the Birman territory will be found three small specimens of fibre, viz., the hybiscus, the urina lobata, and pee-law. The first has long been known to yield a good staple; the second furnishes as favourable a result, with these additional advantages—it is of spontaneous growth, and is found in large quantities. The third, from its want of length, has but little claim upon attention.

"The specimen of Bedolee-lath, from Assam, deserves especial notice, for the softness and delicacy of its structure. It is, I think, as a vegetable, the nearest approach we have to silk. Major Hannay, Commandant at Assam (to whom science is deeply indebted), forwarded this specimen to the Agri-Horticultural Society, but without the cost or quantity of production; hence no idea can at present be formed of its value.

"The same remark applies to the samples of muddar, pine apple, and Midnapore fibres, though each has been turned to account in textile manufacture. Of the pine apple there is an extremely light and delicate sample, in the nature of a scarf. The muddar has also afforded good strong cloth, and excellent paper, while the creeping plant of Midnapore, lately discovered by Mr. Cockburn, chief magistrate of Calcutta, is about one of the strongest fibres of its class in India. The most objectionable feature about it is its length, which, though ample for manufacturing purposes, is not long enough for the Calcutta market.

"The sample of *Sida Rhomboidea* was grown last year, in the Agri-Horticultural Society's garden, near Calcutta. It is a dwarf species of corcorus, or jute, but quite as hardy and free growing as the larger species, while the combination of colour, strength, and softness, endow it with vast importance and superiority.

"Of the specimens of jute little need be said, its marketable and manufacturing properties being generally known. I may, however, state, that some portions of it have undergone a process of chemical bleaching, which, while it has augmented the value, has not in the least interfered with the strength or pliability.

"The samples of aloe, and rope made therefrom, are deserving attention. This is a particularly fine rope fibre, and will in time prove a valuable auxilliary to the rope yard. Small quantities, prepared by the Bengalees, at present find their way into the rope making establishments at Howrah, at from 10 to 12 rupees a maund, equal to £26 and £32 per ton. The reason of this high price arises, I believe, from the scarcity of the plant in the vicinity of Calcutta, and the natives do not care about travelling far to obtain it; otherwise, at Chota Nagpore and other places, I was informed it was to be had in almost any quantity. The railway company from Howrah has planted a quantity of the aloe on each side of the rail, doubtless to prevent the Brahmin bulls and other cattle straying on the line. This operation, if carried

out judiciously, will effect the end desired, and prove a source of revenue besides.

"The plantain of Bengal has not, I regret to say, furnished me with such satisfactory results as I had hoped for. I send you various samples, together with a light rope made from it. Its general weakness and brittleness places it much below many other fibres. As a paper pulp, under the influence of proper machinery, I cannot offer an opinion. I can, however, afford the Society the result of a rough experiment I tried, to obtain a pulp and paper therefrom last year. I had a quantity of the fibre cut into small pieces by hand, it was then soaked in water for two months, and afterwards well beaten in a wooden mortar, and again stirred up in water; my frame for taking the pulp out of this last pan was a fine bamboo sieve; with such an apparatus, it may readily be understood what a rough and wretched description of article was turned out, but it was paper, nevertheless. Although I had my product, and in thickness more like paste-board than paper, it wanted tenacity, and readily cracked, an idea that may easily be inferred from the straw-like nature of the samples. Doubtless other species afford better fibres; indeed one of the tribe, in the vicinity of Dacca, I have heard yields almost as strong a rope fibre as any is in India.

"The next article worth attention is the Danche. When properly treated it possesses amazing tenacity, and withstands the action of water and dilute acids well. It is largely grown, and seemingly little cared for beyond being made into mats for sheltering the pawn plant from the sun; afterwards the dried sticks are used for blazing the bottoms of the natives' boats when they are desirous of burning off the old pitch. Rope is made of it at Howrah, and a sample was sent to the Exhibition by Messrs. Thompson, of that place. The specimens sent to the Society afford some idea of the durability of the Danche. They were taken off sticks which formed portions of a pawn mat, and as such had done duty for six months, exposed to the trying heat of a tropical sun. It is easily cultivated, and requires little trouble after once sown, and when cut before flowering, is, as usual with fibrous plants, much stronger than afterwards; but this the natives, if aware of, pay little attention to.

"The last but most important of the specimens I shall allude to is the Rheea or China grass cloth plant; this is another of Major Hannay's contributions. There are different preparations before the Society; one portion was grown at Aasam, but prepared by myself at Cossipore; the other was grown under my supervision, and likewise prepared by me at the same place. It may truly be declared to be the most important of fibrous plants yet discovered in India, and cannot fail in a few years to become an article of immense export. Hitherto, the great difficulty respecting this fibre has been to get it out of the ribbon or straw-like state. However, I can now pronounce that obstacle overcome, without recourse to machinery or expensive chemical operations, as the samples exhibited testify."

ECONOMIC MUSEUM.

A collection of articles, models, drawings, and publications, tending to promote health, comfort, and economy among the industrial classes, or to illustrate their present condition in various parts of the world, is now being formed by the Society of Arts, under the management of Mr. T. Twining, jun., one of the Vice-Presidents of the Society. Contributions and communications, home, colonial, and foreign, should be addressed to "T. Twining, jun., Esq., Society of Arts, Adelphi, London."

By order,
P. LE NEVE FOSTER,
Secretary.

Home Correspondence.

MR. P. L. SIMMONDS ON THE GUMS AND RESINS OF COMMERCE *v.* THE "ENCYCLOPÆDIA BRITANNICA."

SIR,—My attention has been directed to a paper published in the *Journal* of Nov. 30th, "On the Gums and Resins of Commerce," by P. L. Simmonds, in which the writer, after referring to the want of information on these substances, either in the home or foreign publications, proceeds to say:—"Grave errors continue to be propagated in standard works from day to day; even in a publication of weight and influence like the 'Encyclopædia Britannica,' most of the details in the articles, as given in the new edition—as far as it has proceeded—are nearly reprinted verbatim as issued in its pages some thirty or forty years ago."

Had this been a vague general charge, it might not have been easy to refute it; but as Mr. Simmonds has directed his animadversions to a particular department, I shall have no difficulty in proving the utter groundlessness of this reckless denunciation. Of the gums and resins referred to in the paper read to the Society, and such as I considered it necessary to notice in the volumes already published of the new edition of the "Encyclopædia Britannica," the following is the list as far as I recollect:—Aloes, Amber, Ammoniac, Anime, Bdellium, Colophony, Copal, Dragon's Blood, and Euphorbium. Of these, the first is a new article, which has no place in the previous editions; the next, amber, is a new and improved article; the next two are reprinted from excellent articles by Professor J. Thomson; the remaining five are inserted for the first time in the "Encyclopædia Britannica." Thus, instead of being reprints, *six out of the nine articles are printed for the first time in the "Encyclopædia Britannica," not having appeared before in that work at all, and the seventh supersedes the article in the previous edition.*

Although I cannot believe that such misrepresentations are intentional, yet, as they are calculated to mislead the public, and to have the same effect on the property of individuals as the torch of the incendiary, I feel myself compelled publicly to contradict them.

The "Encyclopædia Britannica" contains contributions of permanent value by writers of the highest celebrity. Many of these would only be deteriorated by alteration by other hands. Of the other articles, however, I can safely affirm that not one in twenty—I might almost say one in fifty—remains in the new edition without modification, addition, or correction, and very many are entirely superseded by new articles, while the pages of the "Encyclopædia" continue to be enriched by original contributions from the most distinguished names in science and literature.

I am advised that the injurious animadversions in the *Journal of the Society of Arts* are actionable; but as my object is only to vindicate the character of the work which I have the honour to superintend, I will thank you to give this letter a place in the next number of your *Journal.*

I am, Sir, your very obedient servant,
THOS. STEWART TRAILL,
Editor of Encyc. Britan.

Edinburgh, Dec. 13, 1855.

The Editor of the *Journal of the Society of Arts*, having forwarded a copy of Professor Traill's letter to Mr. Simmonds, has received the following reply:—

SIR,—I have to acknowledge the receipt of the copy of Professor Traill's letter, with which you have favoured me, animadverting on the brief allusion to the *Encyclopædia Britannica*, I made in my paper "On Gums and Resins," and to which I proceed to reply.

The Society's *Journal* is scarcely the place to go into an elaborate disquisition on the merit of the arcticles in

the new edition of the *Encyclopædia*, particularly with the threat of action alluded to by the learned editor. In these days of free discussion and independent criticism, one would have supposed it would have been sufficient to let the work rest on its merits, and that no remarks from so humble an individual as myself could have any injurious effect on a work of such established character, "enriched by original contributions from the most distinguished names in science and literature."

The successive editions of the *Encyclopædia Britannica*, from the 1st, in 1771, down to the 8th edition in the past and present years, have, without doubt, contained "contributions of permanent value, by writers of the highest celebrity;" but I cannot admit that many of these would only be deteriorated by alteration by other hands. In the articles on Gums and Resins, I still think there is room for much improvement and addition, to keep pace with the botanical discoveries of late years—the chemical analyses of modern investigators, and the enlarged application of many of those substances to new purposes. Since Nicholson published his "Dictionary of Practical and Theoretical Chemistry," nearly half a century ago, a complete revolution in the whole circle of chemical operations, and of the arts and sciences, has taken place, and the text of that work, which then formed the basis of the articles for the *Encyclopædia Britannica*, the *English Cyclopædia*, *Ure's Dictionary of Chemistry*, and other works, is nearly wholly inapplicable in 1855.

But I will go through Professor Traill's defence of the articles he enumerates *seriatim*, being such as "he considered it necessary to notice in the volumes already published" of the last edition.

Firstly: "The new article," ALOES, "which has no place in the previous editions." Not coming properly within the category of either "gums or resins," but being a watery extract, aloes was not spoken of at all by me, except so far as estimating the total import in a summary at the end of my paper.

Secondly: the article AMBER, the least important of the resins, is re-written to a certain extent—but no allusion whatever is made to its use in varnishes.

Thirdly: AMMONIAC. With the exception of five new lines, specifying the plant that produces it, and that it is obtained in Prussia, the rest of this article is *verbatim* from the old edition.

Fourthly: ANIME. Nine lines are devoted to this resin; and, with the exception of four words cut out, it is *verbatim* as in the old edition; and, I may state, that my comparison refers to the edition of 1812.

The word ARABIC does not appear at all; and yet, as I pointed out, this is one of the most important gums of commerce, our imports reaching 3,000 tons annually.

ASSAFŒTIDA, which occupied two lines of space in the old edition, is extended to seven lines in the present volume.

The important genus BALSAMODENDRON receives four lines of notice, and BENZOIN five lines.

Of the articles for which Professor Traill takes credit as being "*printed for the first time in the Encyclopædia Britannica, not having appeared before in that work at all!*" the important character of the information may be estimated from the space devoted to them. BDELLIUM has three lines, COLOPHONY four, DRAGON'S BLOOD eight, and EUPHORBIUM seven lines.

ELEMI is also a new article of five lines.

COPAL is the only article to which a fair proportion of space is accorded; but, even then, much of the information is obselete, and the plants furnishing the resins incorrect.

Those who have read the prefatory remarks in my paper, will remember that they were intended to be of general application, as to the imperfections and shortcomings of many publications, usually referred to as standard authorities, and that they were not intended to apply singly to the *Encyclopædia Britannica*. It is not necessary for me to follow Professor Traill in his defence of the other articles, as to whether there be one in twenty or one in fifty unaltered. I have contented myself with directing my animadversions to the particular subject which I was at the time discussing, and I leave impartial readers to decide upon the correctness or "groundlessness" of my remarks, merely adding in conclusion, that an excellent opportunity offers for Professor Traill to enlarge the very meagre article, under the head of "Gums," that has usually appeared in the *Encyclopædia*, and to bring down the information on this important article of commerce to the information of the present day, so as to assist the investigators, home and foreign, seeking information through the pages of the *Encyclopædia Britannica*.

I am, sir, your very obedient servant,

P. L. SIMMONDS.

8, Winchester-street, Pimlico,
Dec. 18, 1855.

THE PARIS EXHIBITION AWARDS.

SIR,—The short time at my disposal last week, on account of the lateness of the discussion, precluded my making more allusion then to the awards of the Paris Exhibition. A glance at the list of awards, by any person having some knowledge of the general trade of the United Kingdom, will convince him that an under-current has been at work in the whole affair. The Executive could not overlook, without exposing their motive, the world-wide renown of some of the British exhibitors—such, for instance, as the engineers; but in those cases where a successful rivalry in manufactures interfered with the French, the awards have been very scarce, and those of a class too low to be looked upon with any degree of pride by British manufacturers. Were it likely to "melt away" the existing reputation of British exhibitors, the contributions from England would do us a serious injury; but after all, the public are the best judges in these matters.

In those manufactures where there was no rivalry with the French, medals have been showered in profusion, even in cases where no striking invention was shown. From what I have recently heard, I attribute these singular adjudications to the intrigues of the recently-appointed and arbitrary "Committee of Revision."

It would be a safer plan for intending exhibitors in future Exhibitions to withhold their goods till they have convinced themselves that the juries are constituted in such a manner that, from the practical knowledge of its members, there would be a good chance of an equitable classification of their awards, and that these should not afterwards be tampered with.

In the carriage department of the recent Paris Exhibition, the claims of the exhibitors to at least a reasonable representation of their trade in the jury seem to have been overlooked in a most careless manner. The first-class awards in many other departments have been awarded to articles of superior and excellent workmanship, without being actually striking inventions, or produced by new processes. The English carriages show a marked progress on those of 1851, and they, at least, in common fairness, should have been accordingly rewarded. This is an example of a trade competing successfully with France in the markets of the world, and is an illustration of my former remark. However, English coach-builders seek only "a fair field and no favour," and are prepared to win their way, notwithstanding an attempt to extinguish their reputation by a side-wind. There seems to have been a mistake made as to what a carriage really is, in the classification of manufactures for the convenience of adjudication; it is as much an "art manufacture" as any trade can be which depends so much on the taste displayed in its various proportions and appointments; and it is, besides, a peculiar "mechanical manufacture," demanding very careful study and observation to accomplish successfully, and should, as such, have a fully competent jury to itself. The including such extraneous goods as portmanteaus with carriages in the classification, may show

that it is still capable of improvements for future Exhibitions.

Having just received from a friend in Paris, the official list of the whole of the British and foreign awards published in the "Moniteur," I am better enabled to guess at the principle which has guided their distribution. First, I find that a proportion seems to exist between the medals and the quantity of goods sent by each state. France, naturally, from facility of access, sending large contributions to represent her commerce, receives more than a reasonable proportion, some deservingly, and many edged in to complete the required number. England (a good ally) has a larger proportion than other states, "per favour." Belgium has a proportion of rewards to the contributions. Austria, showing a variety of inferior carriages, is rewarded, though far surpassed by little Sardinia, which shows only one carriage, and receives a lower grade of commendation. Hamburgh, showing one carrriage also, but putting Austria quite in the shade as regards quality, is placed in even a lower grade. It may be conjectured from these facts, that the jury of the carriage section has not been very successful in its selections; the misappropriation of some of the awards, where articles had nothing to recommend them, seems to favour the notion of a political sham having assumed the place of stern justice.

The time approaches for a reform of many of the abuses of these exhibitions of manufacture. What should we think of judges in our law courts being appointed who had not studied the law. In an almost equal degree, the Exhibition judges require to be selected from men well up in their several callings. Until the exhibitors and the public have full confidence in the justice of the awards, they will not be valued as they are intended. The surprising fact mentioned by your correspondent, that the names of 200 eminent manufactures who had been selected for gold medals had been reduced to a lower class, is likely to have been a measure of economy in the distribution of so much gold in war time. There was, in fact, no necessity for a golden award, as was shown in our Exhibition of 1851, where the Council Medal of bronze carried quite as much prestige as one of gold would have done; in fact, a mere written certificate would have economically superseded either, and, I believe, been equally appreciated by most of those who receive the highest commendation; they do not look to the fact of an award of a certain weight of precious metal, but to the acknowledgment of a rising or developed talent. Abler pens than mine will, I trust, take up the subject. I conclude with a simple fact, which has lately come to my knowledge with respect to the carriage department. One of the best carriages shown by England was altogether omitted from the list of awards; it has just been purchased by Prince Napoleon, and a high official at the Court of Holland has ordered a counterpart to be made, both on account of its excellent style and workmanship.

I remain, Sir,
Your obedient servant,
GEORGE N. HOOPER.

Dec. 10, 1855.

DECIMAL COINAGE.

Sir,—It would be a slight help to the decimal movement if in elementary works on arithmetic, the money table were amended, and made 4 farthings = 1 penny, 12 pence = 1 shilling, 2 *shillings* = 1 *florin*, 10 *florins* = 1 pound.

Yours, &c.,
HYDE CLARKE.

RELATIONS BETWEEN THE ENGLISH AND GERMAN MONETARY SYSTEMS.

Sir,—It is announced that a monetary congress, on behalf of German States, is shortly to be held in Berlin. Being aware that the *Journal of the Society of Arts* is received and appreciated by some eminent scientific associations in that capital, I avail myself thankfully of permission to submit the following computations, showing relations which actually exist, as also others which might with facility be established, between the group of monetary systems based upon the German mark on the one hand, and those based upon Troy-grain weights on the other hand.

The accomplished Berlin correspondent of the *Times* assumes, as an accepted fact, that the mark of fine silver will be treated as corresponding to two guineas of our money, so that 14 Prussian thalers already coined out of that weight, and 21 German florins to be coined out of that weight, will respectively correspond to £2$\frac{1}{10}$ sterling.

He further mentions an intention to introduce into the monetary systems of Germany, a gold coin corresponding to the English sovereign, an intention which betokens much prudent foresight on the part of German statesmen.

In my paper, read before the Society of Arts, and printed in its *Journal* of 16th February last, it was shown by what stages the United States of America had altogether discarded silver as a standard of value, and replaced their silver dollars with gold ones, leaving only silver fractions of a dollar to serve as legal tenders for small change, up to 5 dollars; a limit by one-half lower than that to which English silver coin is a legal tender.

The same paper alluded to measures taken by France, another great commercial nation, to fill up with gold coin the gaps in its currency caused by the exportation of its silver money. Did the space at my disposal permit, I could quote startling statistics, exhibiting the enormous extent to which gold has been supplanting silver money in France, down to the five-franc-piece, now coined in gold.

Germany, by familiarising her people with gold money, pursues the only course whereby to become prepared for adopting it as a monetary basis whenever German interests shall recognise its superior advantages. The American people have already bartered away their silver dollars at a considerable profit. France is rapidly, but unostentatiously, pursuing a like course, and now begins Germany's opportunity.

The interesting calculations furnished by Dr. Soetbeer (in his valuable book on "Bank und Geld Fragen," which has but lately reached my hands), shows the continued augmentation in the price of silver paid in gold. The demand for silver in China,* India, and other eastern regions, seems insatiable. Is it difficult to account for this? Supplies for enormous armies, drawn from tribes not previously commercial, create among them a need for currency, which "grows with what it feeds upon." Commerce, as she extends her sphere, draws within her influence masses of people, comparatively unfamiliar with coin, and disposed for some time to hoard it. Thus railways and trading ships, acting in some directions, and more arbitrary instruments operating in others (upon the coasts of China, Japan, &c.), inoculate myriads with the greed of money. The coin which obviously best suits a nascent trade is silver, the less precious, therefore more bulky, metal; always, and everywhere when present, the precursor, among primitive traders, of the more precious and compact money. If Great Britain, America, and apparently France, all beginning with silver alone, mark their attainment of commercial eminence by adopting gold, and filling up the interstices of their currency with the refinements of token or representative money, will not Germany, too, assert her progress towards commercial eminence, her conquests in the arts of peace by "bereitschaft," to take advantage of monetary eventualities.

I assume the absence of any prejudice which might prevent an adjustment of the new gold standard of Germany, to that which happens to be the most widely distributed common measure (in gold money) of the commercial world, just as the Spanish dollar or piece-of-eight

* Vide Custom-house returns of silver exports.

has been as a common measure in silver. Witness the millions of sovereigns exported for years past, having been coined for the world at large, without any charge or deduction whatever, Australia now coining sovereigns out of the gold produced on the spot.

Given—

marks.		grains.		lbs. avoir.
16	=	57·743	=	82·49

£1 sterling contains 113 grains fine gold.
£511 do. do. 16 marks do.

Assume—

Ratio of gold to silver, 365 : 24 = $15\frac{5}{24}$: 1.

Results—

1 mark fine silver = 14 thalers = 21 florins = $21 \times £\frac{1}{10}$.

Now the least inconvenient mode of adjusting one currency to another, is by the assay. For example:—One kilogramme produces 100 Dutch florins 94½ per cent. fine = 200 francs 90 per cent. fine.

The assay, titre, standard, or quality of a coin rarely concerns any beyond the Mint and the bullion-dealer. Symmetrical, say decimal, titres are convenient theoretically; but, out of their original sphere, no coins are accepted as of the exact weight, fine contents, &c., ascribed to them at home. Deviations, such as mint "remedies," dirt accretions, turns of the scale, legal allowance for wear and tear, and the like, explain wherefore gold francs and gold United States dollars, though both 9-10ths assay, are never bartered against each other weight for weight; nor indeed are silver francs of different nations so bartered. (Vide my paper in this *Journal* of 16th February, 1855.) If, therefore, I suggest an assay for the new German money, which seems exceptional, no real embarrassment can result therefrom. Suppose the assay adopted be $93\frac{1}{4}\frac{1}{4}$ per cent. fine, then one mark of gold of that standard would contain precisely as much fine gold as is above attributed to 30 sovereigns.

Hence the mark of gold $93\frac{1}{4}\frac{1}{4}$ per cent. fine, would represent—

200 thalers = 300 florins = £30 sterling.

Let me now justify an assignment of the ratio of gold to silver as $15\frac{5}{24}$ to 1. Dr. Soetbeer's tables show that in Paris, notwithstanding the double standard, the ratio of gold and silver has during the last 24 years fluctuated to the extent of about 2·61 per cent., and from 1848 to 1854 inclusive, it has fluctuated from 15·94 to 15·36. In London the range of fluctuation for the same 24 years is shown to have been about 3·86 per cent., and during the last eight years of that period the maximum ratio was 16·13, the minimum 15·12. In Hamburgh the range of fluctuation for the same 24 years is shown to have been about 3·91 per cent., and during the last eight years of the period ending with 1854, the maximum ratio was 15·84, the minimum 15·10. It will moreover be found that $15\frac{5}{24}$ does about indicate the mean actual ratio in Hamburgh prevailing over a recent period.

Here the space at my disposal admonishes me to curtail my remarks. In thus offering my humble contribution towards the endeavours made to simplify the relations existing between various standards of value, weight, dimension, &c., I by no means expect to be ranked with those benevolent theorists who, anticipating an easily established community of standards, would meanwhile discourage progress and improvement in what happens to be really within our own control. The Royal Commission, so far as its function is to determine between rival projects for adjusting to decimal or common arithmetic the already established monetary system of the country, will virtually have little to do beyond making an election between the penny and the pound as the *norm* of decimalised reckoning. As Dean Swift would say, it is a feud between the big-endians and the little-endians. The former say—Proclaim that the twentieth of £1, or shilling, shall, after a certain date, be equivalent to 12½ pence instead of 12; the latter plead for the building up of a new decimal coinage upon the basis of the intact penny, discarding both pound and shilling in the process. Since the appointment of the Royal Commission, I have abstained from public controversy in the suit of "the penny *versus* the pound and shilling," being content that the whole inquiry shall be re-opened and dispassionately decided. As against the alarmists who deprecate improvement, simply because it is a change, effective service is being rendered by showing how exceedingly simple is the task before us compared with the complexities which had to be overcome in France and other countries. Mr. Henry Johnson, of Crutched friars, has recognised the proper function of the Society of Arts in practical public questions such as these, by presenting to its museum full series of existing decimal coins, their decimal multiples and submultiples, gold, silver, and copper. If to these were added the octonal, duodecimal, and other small change for the same units, which change, after circulating for a time side by side with the new decimal change, had eventually been superseded thereby, a useful practical illustration of how the difficulties have been surmounted might by that means be afforded.

Yours, &c.,

J. A. FRANKLIN.

London Institution,
Dec. 17, 1855.

Proceedings of Institutions.

Huddersfield.—The annual *soirée* of the Mechanics' Institution was held on Thursday evening, the 13th inst. in the Philosophical Hall. The hall was decorated with evergreens and banners, and over the orchestra was the motto "All can aid." Ranged round the hall were specimens of drawing and writing. Several of the best were the works of George Clayton, of Huddersfield; Alfred Walker, of Rastrick; and Amos Booth, of Kirkburton. The two last-named youths walk a distance of five miles, after their ordinary work, to attend the Institution, and five back again after the class-work is done. The chair was occupied by the Very Rev. the Dean of Hereford, supported by the officers of the Institution, as well as by the Presidents of many others in the neighbourhood. A great number of the students were also present. The evening's proceedings were enlivened by the performances of Miss Witham and Mr. Garner; Mr. J. Wood, presiding at the piano. The proceedings commenced by the Chairman calling upon the Secretary, Mr. F. Curzon, to read the report. After speaking of the gradual progress and growth of the Institution, the report proceeded to state that, after two removals, it appeared to be advisable, in the year 1850, that the Institution should possess a building of its own. Subscriptions were raised, but the aid thus obtained being insufficient, a mortgage had to be effected, of which £900 is as yet unpaid. The building contains twelve class-rooms. One—

"filled with adults, some of whom a few years since were destitute of more than the merest elementary education. Now, many of them are prosecuting the study of the advanced sections of arithmetical study, and in other departments of knowledge possess no mean acquirements. In two adjoining rooms men are still found who are spelling their way through the simplest reading lessons, or having their horny hands guided in the first use of a pen. We will now enter one of the lowest elementary class-rooms, where the boys under eighteen assemble. Most of these are from eleven to fifteen years of age. About sixty are present, following the teacher in a simultaneous lesson in grammar. By a succession of these lessons it is sought to fix the study in their minds, and, as in every other department, the pupil moves from class to class through the various branches of the science. Two of these large elementary classes may be especially noticed; one, the junior singing class, where from sixty to seventy are taught the rudiments of music, and a still larger class for free-hand drawing, where the copies of the Government School of Design are used, and from which, through the culture of these youths, the homes of the neigh-

bourhood receive their first acquaintance with true art, and by whose aid the manufacturers may obtain skilled artisans and educated designers. The drawing classes are still, as they have been for many years. under the kind and gratuitous superintendence of Mr. Tomlinson. The machinery by which the Institution is kept in motion differs from that of most others, and, we believe, originated within its walls. The boy or adult who desires to become a member. presents himself on any of the evenings of the week at the Institution, where, at the under-secretary's office, he pays his entrance-fee of 6d., and 3½d. a week for as few or as many weeks as he chooses to join—a single week, if he pleases—either from having only a passing object, such as consulting a book, or returning to a branch of study for some special reason. If he re-enters within six months he has no entrance-fee to pay, but simply to inquire for his old card, which is placed in an alphabetical niche, ready for him at any time, and has his present payment entered against the tabulated date at its back. He passes thence to the secretary, who, after the member has himself entered his name, age, occupation, name of employer, and abode, examines him as to his present attainments and previous advantages, whatever they may have been. And it is found that although eight out of ten have derived some aid from Sunday or day school, the rest commence their education in our classes, and from the generally irregular attendance at day schools, the education they have ordinarily received is supplemented very valuably. After examination the new member receives a probationer's ticket for his classes, which is changed when his teacher certifies, and the secretary confirms, the propriety of his promotion. If he falls into arrear in his payments, as soon as the debt is a month behind he is visited by the secretary. This is a work of considerable labour, more than 900 such visits having been paid in the past year, but it is of great value, keeping the knowledge of the members well before the officers and committee, as well as the various circumstances from which the debt and generally consequent absence have arisen. If too poor to pay the 3½d. per week, and he is under eighteen years of age, he may fall into the hands of one of the 150 annual members, whose subscription mainly covers the expense of his education, diminishing the cost to the boy to 1d. per week. The presentees of the annual members were formerly wholly free, but the experience of the Institution is altogether against giving education, even to the very poorest the youths valuing what is paid for immeasurably beyond what is given them. A library, containing about 2000 volumes, is open two evenings a week, and is under the care of four gratuitous librarians. The annual issue reaches 9000 volumes. The reading-room is supplied with nearly forty newspapers and periodicals, and is open on the six days of the week, ten hours a day. Two distinctive features, however, remain; one, an occasional coffee soiree; where the directors and teachers assemble for friendly conference, and the other a monthly meeting, the last Saturday evening of the month being chosen, where, without charge, the members and their friends gather and hear a brief lecture and a concert of carefully selected music. A very valuable feature has been introduced this year into the teaching, which also demands remark. On the Monday evening, after an hour has been spent in the customary reading lesson, the classes are collected in three of the largest rooms, and a short conversational lecture is delivered by the teachers or other friends. In the past twelve months, too, perhaps the most effective branch of the Institution has been greatly extended, a series of elementary adult classes, meeting every night in the week, occupying a couple of rooms, and attended by forty persons, whose ages range from eighteen to forty-five years, and who, on their entrance, were in some cases unable to read or write, and in every other instance were at the lowest point in education. They are the most earnest of all our students. The present state of the Institution is encouraging. Last year at this time there were of all classes of members 712. There are now 830. 147 of these are annual members, most of whom are not direct participants of the advantages of the Institution. Of the rest, seventeen out of every twenty attend the classes. It is one of the most pleasant things we have to record, that the attendances of the 600 pupils in class were, during the last week in November, no less than 1,451. The classes now number 74, of which 46 are elementary and 28 advanced. Of the elementary, 18 are writing and arithmetic, and 17 reading classes. They are conducted by a staff of 14 paid and 41 voluntary teachers. The number of members at any one time does not, however, adequately represent the area of labour in which the Institution works, as during the last twelve months, no less than 1,240, exclusive of annual members, have, for a shorter or longer period, passed through the Institution, 1,150 of whom have entered the classes, and the great majority even of those not now upon the list of actual paying members still consider themselves in connection with the Institution, only having for a time withdrawn from long hours, straitened means, illness, or other causes. Taking the gross population at 40,000, and the persons within whose range of age and sex the society has a right to expect its members, without distinction of class or means, at about 5,000, 25 per cent. annually receive some amount of instruction from the Institution. Very much more than this could be done with augmented means. The class-rooms are yet without sufficient scientific apparatus, and are not well furnished with either maps or diagrams. Many of the class-books might with advantage be replaced by more recent publications, although there are as yet few extant adapted to the requirements of Mechanics' Institutions, whilst the services of professional teachers are much more largely required. In the past year an experiment has been tried of awarding prizes for the good conduct, attendance, and advancement of the pupils. It has been attended with success. To a certain extent each of these objects has been promoted. [For a full report of this meeting, see *Journal* for October 19, 1855.]

The report concludes by stating that H.R.H. Prince Albert has given a donation of £25 for the prize distribution of 1856. Viscount Goderich, M.P., Mr. Tindal Atkinson, Mr. George Beaumont, of Bradford, and others have offered aid for the same purpose, whilst the last gentleman has contributed £2 to the library, and Mr. Atkinson and Viscount Ingestre have both promised lectures in the coming year; and Sir Charles Trevelyan, known for his report on the organisation of the civil service, has promised the forthcoming volumes of Macaulay's History of England. From Mr. Lindsay, the member for Tynemouth, a donation of five guineas has also been received. A very valuable testimony to the usefulness of the Institution has been rendered in a letter from Mr. John Brooke, of Armitage-bridge, which was accompanied by a donation of £10, and an annual subscription of £2.—The Very Rev. the Dean of Hereford then rose and said that, last year, on a similar occasion, they were told by the chairman, Sir Joseph Paxton, M.P., of the defects and wants in the education of our skilled workmen, and how to remedy them. Now he should be able to speak on Popular Education in general, and thus the addresses would not form a bad sequence. He observed that until very lately Mechanics' Institutes, with the exception of those in some of our large towns, had been entire failures. He was persuaded that if they ever were to be successful, either as places of class instruction in the ordinary branches of education, or of instruction by lectures in the physical and mechanical sciences, it would mainly depend on the education which was given in our elementary schools, and which was now gradually assuming a very different and improved character from what it had some ten or fifteen years ago. This improvement within the last ten years was owing to several causes;—to the efforts of the different educational societies, and also of individuals; but mainly to the Committee of Council on Education—to the inspection of our schools, the apprenticing of pupil teachers, the examination of masters and mistresses for certificates of merit, and the augmentation of salaries following upon this—and in no little measure to the recommending and making known better modes of instruction, better apparatus, and class-books for our schools. He thought that the present system was preparing the way for a more extended and national one at no distant period, and he was by no means certain that we should not arrive at this much sooner by working on for a time as we are, than by attempting any scheme which the country is not prepared to support, and which, if attempted in parliament at present, judging from last session, there is not much chance of our getting. He then referred to what, in his opinion, education was intended to do, and contended that it ought to be placed within the reach of all classes. This might, and no doubt ultimately would be accomplished by a system of local rates in aid of education. In the meanwhile, much might be done by the great employers of labour and great

landowners—and he was glad to observe that some eminent firms were taking a lively interest in the education of those around them. Still he should be better pleased if he could think that this feeling pervaded the whole class of employers of whatever grade—not alone in manufacturing employments, but also in farming. He next spoke of the disgraceful state in which our educational charities had been allowed to fall, and expressed the hope that the Charity Commissioners would for the future prevent the misuse and abuse of these endowments. With regard to the Institutes, he felt that they had from want of funds undertaken to amuse the public, instead of trying with zeal and determination to educate their members. The only remedy which suggested itself was, to introduce good class instruction in all branches of knowledge likely to be useful. To do this effectually, unpaid teachers must not be relied on, but there should be provided well qualified paid teachers. This should be supplemented by systematic examination and inspection emanating from some central board. For himself he had, from much experience, come to the conclusion that government aid and inspection was invariably a benefit, and generally speaking, schools not inspected are inferior in teaching power and efficiency. He then alluded to the last annual report of the Yorkshire Union of Mechanics' Institutes, to that of Mr. Phillips, the agent and lecturer to the Union, and particularly to what was being done by the Huddersfield Mechanics' Institute itself. He afterwards referred to a very important report presented to the British Association at Glasgow this year, by a committee of men the most eminent in science in this country, (of which Lord Wrottesley, President of the Royal Society, was chairman) recommending among other things, "That professors or local teachers be appointed to give lectures in science in the chief provincial towns, for which philosophical apparatus shall be provided; and that arrangements be made for testing by examination the proficiency of those who attend such lectures." This plan if adopted would eventually give to the Mechanics' Institutes in towns where such lectures are established, a position of usefulness which they cannot otherwise attain; and although it might be too much to expect to see this carried out extensively at present, still, as is suggested by Sir Charles Lyell, it might be well to commence by establishing lectures in those towns which have shown the greatest taste for scientific knowledge,—in which from considerations of a local kind, such lectures would be likely to do most good, and to gain a permanent footing. This would be a step highly approved of by educational men throughout the country. He concluded by congratulating the Institute on the measures of success which had already attended its efforts.—In the course of his observations, he alluded to two letters he had received, one from Sir Charles Trevelyan, of the Treasury, and the other from Mr. John Wood, Chairman of the Board of Inland Revenue. The latter gentleman says, in his letter, "I shall be very glad, if on your visit to the Mechanics' Institution at Huddersfield, you find that an occasional prize of an exciseman's place is likely to promote merit, and stimulate exertion; and that a call is made on me for one appointment annually."—Several other gentlemen addressed the meeting in support of the following resolutions, which were passed unanimously:—

1. "That Popular Education, as affording one of the fundamental and most enduring conditions of national order, prosperity, and strength, deserves the hearty support and co-operation of all classes of the community."

2. "That Mechanics' Institutions, as furnishing effective means to the industrial population, by which the deficiencies of their early training can be supplied, are most important instruments of popular education, and have a strong claim upon the exertions of all for their promotion and development."

3. "That the Huddersfield Mechanics' Institution, by its regularly organized system of nightly classes for instruction in numerous departments of knowledge, offers to those whose evenings are at their own command, a profitable mode of occupying their leisure, and an advantageous opportunity of promoting their moral and intellectual advancement."

The proceedings closed with a vote of thanks to the chairman.

TUNBRIDGE WELLS.—The Useful Knowledge Institution (and, indeed, the town generally) has gained a great acquisition by the addition to its members of Mr. Joseph Simpson, late Librarian of the Islington Literary and Scientific Society, who not only materially aids the Committee by his judicious advice and hearty co-operation, but delivered gratuitously, on Tuesday evening last, an eloquent Lecture on "Lectures as a Means of Acquiring Knowledge," in which their various uses and advantages were ably pointed out, and the benefits of Institutions energetically enforced. The chair was occupied by Mr. John Field, President of the Institution.

MEETINGS FOR THE ENSUING WEEK.

MON. London Inst., 7., Mr. Charles Cowden Clarke, "On the Genius and Comedies of Molière."

WED. London Institution, 3, Mr. Robert Grant, "On Elementary Astronomy."
Microscopical, 8.

THURS. Royal Inst., 3, Prof. Faraday, "On the Common Metals."
Numismatic, 7.
London Inst., 7, Mr. R. E. Grant, "On the Natural History of Animals."

SAT. London Inst., 3, Mr. T. A. Malone, "On the Elementary Principles of Animal and Vegetable Chemistry."
Royal Inst., 3, Prof. Faraday, "On the Common Metals."

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette December* 14*th*, 1855.]

Dated 19*th October*, 1855.

2342. William Tatham, Rochdale—Improvements in machinery or apparatus for preparing, spinning, doubling, and winding cotton, wool, flax, silk, or other fibrous substances.

Dated 22*nd October*, 1855.

2359. Alexander Parkes, Burry Port, Llanelly—Certain preparations of oils for, and solutions used when waterproofing, and for the manufacture of various articles by the use of such compounds.

Dated 23*rd October*, 1855.

2369. John Bellamy, Lower-road, Islington—Improvements in graining and in producing imitative ornamental surfaces, and in certain instruments or apparatus to be employed for such purposes.

Dated 29*th October*, 1855.

2409. Thomas Ato Temperton, Manchester—Improvements in shells and rockets, and other projectiles of a like nature.

Dated 6*th November*, 1855.

2495. Edward Jeffreys, Shrewsbury—Improvement in the construction of furnaces.

Dated 7*th November*, 1855.

2512. Henry John Betjemann, New Oxford-street—Improvements in expanding or extending tables. (Partly a communication.)

Dated 12*th November*, 1855.

2535. William Crosley, 16, Westbourne-park—Improvements in gas meters.

2537. Louis Joseph Frédéric Margueritte, Paris—Improvements in the manufacture of vitreous products.

2539. William Kemble Hall, 36, Cannon-street—Improvements in boilers for generating steam. (A communication.)

2540. George Cooke, Kersley, Lancaster—Improvements in flyers used in roving and slubbing frames.

2541. Thomas Hitt, Tavistock-street—A new method of obtaining power for propelling vessels and certain new propelling machinery.

2543. William Henry Aston and Samuel Hopkinson, Zetland Mill, Huddersfield—Improvements in steam boiler furnaces and apparat is employed for supplying water to steam boilers.

2545. Andrew Barclay, Kilmarnock—Improvements in indicating the pressure of steam and other fluids, which improvements are also applicable to governors and other regulating apparatus.

2547. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture or preparation of hard india rubber, and

in the application thereof to the construction of parts of textile and other machinery. (A communication.)
2549. William Henson, Bryan-street, Caledonian-road, and Henry Oscar Palmer, Castle-street, East-street, Marylebone—Improved apparatus for propelling vessels.

Dated 13th November, 1855.

2551. Fischer Alexander Wilson, Adelphi-chambers—Improvements in engines, machinery, and apparatus for exhausting, forcing, and lifting, for propelling on land and water.
2553. John Wilkinson, sen., and John Wilkinson, jun., Leeds—Improvements in communicating a shape or configuration to felted cloths and other manufactured fabrics.
2555. John Mawson, Newcastle-upon-Tyne—Improvements in cameras for taking photographic pictures.
2557. Robert Murdoch, Cran-hill, Glasgow—Improvements in agricultural apparatus for sowing seeds and depositing manure.

Dated 14th November, 1855.

2559. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improvements in producing ice. (A communication.)
2561. James Burrows, Haigh Foundry, near Wigan—Improved apparatus for winding coals or other minerals from mines, which said apparatus is also applicable for other similar purposes, and for machinery required for forming or constructing such improved apparatus.
2563. William Barnes, 2, Royal Exchange Buildings—Improvement in connecting and supporting the ends of the rails of railways.
2565. Joseph Robinson, Denton Mills, Carlisle—Improvements in machinery for drying wheat and other grain.
2567. Charles Goodyear, 42, Avenue Gabrielle, Paris—Improvements in shoes and boots when india rubber is used.
2569. Frank Jacques, Droylsden—The use and method of preparation of a new material to be used in the process of dyeing silk.
2571. Alfred Vincent Newton, 66, Chancery-lane—Improved manufacture of electrotype printing surfaces. (A communication.)
2573. Johannes Moler, 3, Maynard-place, Hornsey—Producing a transparent photographic picture on ivory, without injuring the nature of the ivory, so as to be able to finish the picture with colours like other miniatures.

Dated 15th November, 1855.

2575. Franz Duncker, Berlin—A new instrument for electric telegraphs called "Despatch Distributor," which will permit despatches of various contents being communicated at the same time to one or more stations by means of one or two line wires only. (A communication.)
2579. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in carding engines for carding cotton and other fibrous materials. (A communication.)
2581. George Tomlinson Bousfield, Sussex-place, Loughboro'-road, Brixton—Improvements in breech-loading fire-arms. (A communication.)

Dated 16th November, 1855.

2583. Benjamin Talbott Babbitt, New York—Manufacturing soap.
2585. William Eassie, Gloucester—Improvements in hammers.
2587. James Yates and Thomas Rawlins Birch, Birmingham—Improvements in engines for raising beer and other liquids.
2589. Edward Peyton and Duncan Morrison, Bordesley Works, Birmingham—Improvements in manufacturing parts of metal bedsteads.
2591. Louis Auguste Petard, Paris—Improvements in manufacturing velvet and other similar fabrics.

Dated 17th November, 1855.

2593. Joseph Denton, Pendleton, near Manchester—Improvements in looms.
2595. Robert Walter Swinburne, South Shields—Improvements in furnaces used in the manufacture of glass.
2597. George Collier, Halifax, and James William Crossley, Brighouse—Improvements in means or apparatus employed in hot pressing woven fabrics, and other surfaces.

Dated 29th November, 1855.

2692. Arthur William Forde, 45, Bernard-street, Russell-square—Registering the number of revolutions of a wheel of a locomotive engine, or railway or other carriage, at any given period.
2694. William Irlam, Gibraltar Iron Works, Newton Heath, Manchester—Improvements in crossings for railways.

Dated 30th November, 1855.

2700. John Ramsbottom, Accrington, and John Charles Dickinson, Blackburn—Improvements in machinery or apparatus for measuring and registering water and other fluids, and obtaining motive power from the same.
2702. Edward Daniel Johnson, Wilmington-square—Improvement in the construction of attachable seconds watches.
2704. Richard Hancock, Great Polgooth Mine, St. Austell—Cleaning and separating ores of every description when brought into a state of low pulverization.
2706. Samuel Cunliffe Lister, Bradford—Improvements in treating so as to rework waste yarns of cotton, silk, flax, wool, or other fibre.

Dated 1st December, 1855.

2708. William Ward, Warrington—Improvements in looms for weaving.
2712. James Murdoch Napier, York-road, Lambeth—Improvement in drying small coal.

Dated 3rd December, 1855.

2714. George Harrison, Burnley, and William Mitchell, jun., Hoarstone-lodge, near Burnley—Improvements in machinery for roving, spinning, and winding worsted, cotton, and other fibrous materials.
2716. Christian Mayer, New York—Improvements in hair-trigger-locks for fire-arms.
2718. Westley Richards and Joseph Rock Cooper, Birmingham—Improvement or improvements in breech-loading fire-arms.
2720. Jules Roth, Mulhouse, France—Improvement in rollers employed in spinning machinery, and in other parts of machinery used in the treatment of fibrous materials.
2722. James Leitch, Ellenborough-street, Liverpool—Improvements in melting and blowing up sugars.

Dated 6th December, 1855.

2742. Charles Hawker, Fishbourne, Isle of Wight, and Thomas Parry Hawker, War Prison, Plymouth—Improved method of manufacturing cartridges.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2747. Ebenezer Poulson, 21, Judd-street, Brunswick-square—A new constructed engine to be worked either by steam or principally by manual labour.—6th December, 1855.
2792. Jacques Elidat de Malbec, Paris—Improvements in water-closets.—11th December, 1855.

WEEKLY LIST OF PATENTS SEALED.

Sealed December 14th, 1855.

1365. William Clay.
1369. Hippolyte Mathis.

Sealed December 18th, 1855.

1380. Richard Peaker and Thomas Bentley.
1382. Henry Bessemer.
1384. Henry Bessemer.
1386. Henry Bessemer.
1388. Henry Bessemer.
1390. Henry Bessemer.
1399. Daniel Gover.
1400. James Letchford.
1405. William Cartwright Holmes.
1412. Robert Watson Savage.
1413. Uriah Lane.
1414. Elise Cochaud.
1417. Jean François Victor Fabien.
1424. Theodore Bougereau.
1432. Oliver Rice Chase.
1470. Louis Joseph Frederic Margueritte.
1480. Auguste Edouard Loradoux Bellford.
1496. Francis Lycett.
1650. Alfred Booth.
1970. James White.
1998. William Henry James.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

December 10th.

1034. John Thomas Way and John Manwaring Paine.
1073. André Cointry.
1089. Frederick Joseph Bramwell.

December 11th.

1042. Jules Lejeune.
1052. William Irlam.
1065. John Mason.
1090. Archibald Slate.
1128. Ephraim Mosely.
14. Charles Edwards Amos.

December 13th.

1071. Thomas Dunn, Hugh Greaves, and William Watts, jun.
1077. Richard Blades.
1098. George Thomson.
1119. Jean Baptiste Moinier, and Charles Constant Boutigny.
1120. Jean Baptiste Moinier, and Charles Constant Boutigny.

December 15th.

1079. Sir Francis Charles Knowles, Bart.
1127. John Roydes.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3795	December 12.	Perambulator	G. A. Chambers	13, Holywell-row, Finsbury.
3796	„ 15.	Flower Pot	E. Israel	15, Bury-street.
3797	„ 17.	The Volkommen Shirt	Grant, Brothers	Clement's-court.